

## DYNREG

Dynamic Regions in a Knowledge-  
Driven Global Economy  
Lessons and Policy Implications for the EU

## WORKING PAPERS

**The Multinational Corporation and the  
Global Sourcing of Knowledge:  
Remodeling Absorptive Capacity**

**Constantina Kottaridi  
Marina Papanastassiou  
Christos Pitelis  
Dimitrios Thomakos**

**The Multinational Corporation and the global sourcing of knowledge:  
Remodeling absorptive capacity\***

**Constantina Kottaridi**  
University of Peloponnese, Greece

**Marina Papanastassiou**  
Copenhagen Business School, Denmark  
& CIBAM, Judge Business School, University of Cambridge, UK

**Christos Pitelis**  
University of Cambridge  
& CIBAM Judge Business School, University of Cambridge, UK

**Dimitrios Thomakos**  
University of Peloponnese, Greece

**Abstract**

We build on extant theory of the MNC, MNC subsidiaries, absorptive capacity and Penrose's concept of 'productive opportunity' to develop a framework on the MNC and absorptive capacity (AC) that allows us to explore the role of subsidiaries in the global sourcing of knowledge. We develop and test hypotheses using primary questionnaire-collected data. Our results support the idea that subsidiaries' *realized* AC can be improved by the *realized* and *potential* AC of the MNC group and the subsidiary and in turn may improve the performance of the subsidiaries and the group as a whole.

**Keywords:** Multinational Corporation, absorptive capacity, subsidiaries, knowledge

***JEL Classification:***

---

\* This paper is part of a broad research under the program PYTHAGORAS II which is funded by the EU and the Greek Ministry of Education

## **1. Introduction**

There is an ongoing growing literature on the role of organizational innovation as a means of developing and sustaining competitive advantage. Superior dynamic capabilities enable achievement of competitive advantage, which creates virtuous cycles and further strengthens firm competencies. Within this context of knowledge competition, Multinational Corporations (MNCs) are major forces in global Research and Development (R&D) (UNCTAD, 2004). Empirical evidence shows on the one hand that R&D decentralization is not only rising within the MNC group but also expands beyond the confines of the group and on the other hand that the type of R&D carried out abroad goes beyond product and process adaptation, revealing a multifaceted aspect of knowledge sourcing (Cantwell and Janne, 1999; Chiesa, 2000).

At the same time competition pressures have changed significantly the organizational structure of MNCs in favor of a less hierarchical and more horizontal organization (Hedlund, 1986; Bartlett and Ghoshal, 1989). In this organization critical is the role of subsidiaries since they are not perceived anymore as static elements of the MNC structure (Birkinshaw, 1996; Crookell and Morrison, 1990). (Manolopoulos et al, 2005).

In a global environment that is increasingly characterized by technological and market heterogeneity, creative subsidiaries with specific product mandates may constitute an effective way to monitor knowledge flows on behalf of the MNC group. Therefore, headquarters' technology planning should not only screen the diffusion of technology acquired in the home country, but also the technological inputs derived from overseas subunits stemming either from their in-house R&D departments or their established localized knowledge (Ivarsson and Johnsson, 2003; Hakanson and Nobel, 2001; Andersson and Forsgren, 2000; Dunning, 2000; Kuemmerle, 1999; Patel and Vega, 1999).

Cohen and Levinthal (1989) developed the notion of “absorptive capacity” (AC) as the “ability of a firm to identify, assimilate, and exploit knowledge from the environment” (p. 569) that affects firm’s aptitude to innovate and adapt to its external environment, creating thus core competencies. Since then the issue of “absorptive capacity” has attracted the attention of researchers but little has been done to put together issues of international business and AC and how the MNC organization reacts, assesses and builds its AC in order to enhance its ability and performance.

The contribution of this paper is then twofold: Firstly, it offers new theoretical insights in the conceptualization of AC tying it to the MNC organization at the subsidiary level. Secondly, it provides empirical evaluation of specific measurements of absorptive capacity. Under this perspective, it allows us to further understand the evolution of the MNC organization and the impact of the external environment and internal environments in this dynamic process.

The rest of the paper is organized as follows: the next section describes the underlying theoretical framework of external knowledge and absorptive capacity. Section 3 develops the model and hypotheses to be tested. Section 4 provides a brief description of the data and econometric methodology. Section 5 discusses the obtained results and finally section 6 summarizes and concludes.

## **2. Theoretical framework and related literature**

Knowledge creation and diffusion in the MNC has been at the heart of the analysis of MNCs’ operations since Hymer’s (1960/1976) seminal contribution. For Hymer knowledge was one of various ‘monopolistic advantages’, the exploitation of which was most efficient intra, rather than inter-firm for various reasons, such as the ‘tacit’ nature of knowledge, the possibility of assessing differently the value of knowledge by different parties, (or at least pretending to have different perceptions of the value), and even the ability of firms to transfer knowledge intra-firm, more speedily (see Dunning and Pitelis, 2005, for an extensive account). Subsequent work by Hirsch

(1976) discussed the importance of the “*K* factor”, which represents “*firm-specific know-how*” and other intangible income-producing proprietary assets (p. 260) such as R&D.

Buckley and Casson’s (1976) contribution places emphasis on the internalization of “markets in knowledge” (p.34) that leads to “the integration of production, marketing and R&D” (p.34-35). The argument suggests that knowledge has the characteristics of a public good within a firm: “This means that the exploitation of proprietary knowledge is logically an international operation” (p. 35). For Buckley and Casson “...the firm thus operates an international intelligence system ... the international acquisition and exploitation of knowledge will normally involve international production through a world-wide network of basically similar plants” (p. 35).

Acquisition of new knowledge and techniques is nowadays a crucial element in creating core competencies within the MNC group. Nevertheless, acquiring new knowledge is a function of already built dynamic capabilities of the MNC, i.e., of the MNC’s “absorptive capacity”. Cohen and Levinthal (1989) defined “absorptive capacity” (AC) as the “ability of a firm to identify, assimilate, and exploit knowledge from the environment” (p. 569). Their work does not, however, address issues of multinationality, i.e. how a MNC, through its network of subsidiaries can depict different levels of AC and how these varying levels of AC influence a subsidiary’s technological performance. Similarly, Hirsch (1976), and Buckley and Casson (1976) did not recognize at that time that R&D itself is a determining factor of differentiation among the foreign operations of MNCs, i.e. of their subsidiaries. In order to complete the above framework on the evolution of foreign production and multinationals, insights from international management underline that “As the scope and aims of globally competing firms have evolved and widened, the nature and position of individual subsidiaries within such MNC groups have also undergone important changes. These subsidiary-level developments are crucial in influencing the emergence of significant decentralized technological activity in MNCs, and in determining the forms it can take” (Pearce and Papanastassiou 1996:32)<sup>1</sup>. In this

---

<sup>1</sup> See also Birkinshaw et al., 1998; Birkinshaw et al., 2002; Hakanson and Nobel, 2001.

regard, multiple activities of subsidiaries as reflected in the roles allotted to them by their headquarters are of particular relevance in the development and enhancement of their overall AC. The nearest to providing an explanation for the emergence of AC is arguably Penrose's classic 1959 book *The Theory of the Growth of the Firm* (TGF thereafter). In TGF firms are bundles of human and non-human resources under administrative coordination and authoritative communication, producing for sale in markets for a profit. The cohesive shell of the organization, called firm, helps engender knowledge and innovation through specialization, learning and teamwork. In this context a firm's AC is endogenously generated in the very process of firm's operations.

Intra-firm knowledge generation in particular, allows managers to enhance their 'image' of the firm's 'productive opportunity', which Penrose sees as the dynamic interaction between the internal firm environment (resources) and its external environment (industry, markets, the economy), as perceived by managers. These perception by managers in effect define the firm's AC, and the higher this is, the better will tend to be the firm's 'productive opportunity' and ceteris paribus, the firm's performance.

It follows that the Penrosean perspective can usefully complement the Cohen and Levinthal view. This synthesis and our discussion of the MNC literature leads us to the framework depicted in Figure 1.

-----  
Insert Figure 1 here  
-----

\*\*\*\*\*Despite it being extensively analyzed by researchers both in theoretical and empirical levels, AC remains a complex and fuzzy notion due to multiple definitions and components. In broad terms, AC is implicitly accepted as a set of firm

capabilities in acquiring and managing knowledge. Researchers have offered different definitions for AC that capture skills to deal with tacit knowledge (Mowery and Oxley, 1995), the capacity to learn and solve problems (Kim, 1997; 1998), or even receptivity to technological change (Kedia and Bhagat, 1988).

Cohen and Levinthal (1989) have offered the widest and the most influential notion of AC as the ability “to identify, assimilate and exploit knowledge from the environment” (also Van De Bosch, 2003). Zahra and George (2002) expand this concept by adding another element, that of transforming the knowledge, i.e., “capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge (p. 190). In their paper they also introduce two subsets of AC, “potential and realized AC” (p. 185). They define these as follows. “Potential capacity comprises knowledge acquisition and assimilation capabilities and realized capacity centers on knowledge transformation and exploitation” (p. 185). The characteristics of acquisition and assimilation relate to the external environment of the firm whilst transformation and exploitation reflect the internal firm capabilities.

On the empirical side, there are numerous studies that examine AC, using alternative measures depending on the author’s focus and interest. Lane et al. (2001) test the significance of the three components of AC originally proposed by Cohen and Levinthal (1990) for International Joint Ventures learning and performance. An influential study belongs to Kamien and Zhang (2000) who developed a three-stage game to show how the R&D approach and the R&D budget of a firm impacts on its ability to realize spillovers from other firms’ R&D activities, hence how its R&D efforts endorses its own AC.

Most widely used ‘proxies’ for AC include R&D expenditures, R&D intensity and stock of knowledge, as proposed by Cohen and Levinthal (1989). Studies that use such ‘proxies’ include those of Stock et al. (2001), Leahy and Neary (2004), Oltra and Flore (2003). The stock of knowledge proxied by human capital availability has also been used quite a lot in the relevant literature (Rothwell and Dodgson, 1991;

Vinding, 2000; Frenz et al., 2004). A notable extension is by Vegeulers (1997) who captures AC by the existence of an R&D laboratory. Other studies view AC from an organizational point of view, for example, the ability of an entire organization to stimulate knowledge, thus place emphasis on the organizational structure (Van Den Bosch et al., 1999; Welsch et al., 2001; Daghfous, 2004). Schimdt (2005) in a recent study extends traditional measures by including human resource and knowledge management proxies drawing information from a questionnaire survey.

Lane et al. (2002) recognize that despite two decades of influential work on the AC, there are limited attempts to revise the definition of AC and measure it, outside the conventional R&D measures (also Manhe et al., 2005). Although AC has been studied in different contexts, for example, in different thematic categories varying from simple knowledge characteristics to AC and corporate scope and alliances (Lane et al., 2002), there is paucity in the literature as regards the issue of AC within the boundaries of the MNC organization, let alone the subsidiary of the MNC group. Recent work by Minbaeva et al. (2003) is an exception. Their paper departs from the tradition of Cohen and Levinthal in the sense that their measure of AC reflects Human Resource Management (HRM) influences and concerns. They analyze a sample of 169 foreign-owned subsidiaries located in three host countries namely, Finland, Russia and USA. In their work they offer a conceptualization of AC as the ability and motivation of employees to constitute the crucial aspects of a firm's ability to "facilitate internal technology transfer" (p. 589). They also estimate the determinants of AC in a three stages least squares model. In their results they show that employees' ability and motivation independently do not constitute a significant indicator of a firm's AC in the sense that none of the two facilitate knowledge flows in the group. However, their interaction appears to enhance knowledge transmission. Whilst their contribution is enlighting and the construct they use meets the arguments developed by Zahra and George (2002), they do not address the R&D issue explicitly. On the other hand, Veugelers (1997) as noted above measures AC in the "form of a full-time staffed R&D department" (p. 303). The purpose of her paper was to examine the relation between the technological performance of a firm (measured by



“the internally financed intra-muros expenditures (p. 306) of the firm”) and the potential of external collaborations in R&D. Results were in line with Cohen and Levinthal’s notion of complementarity between external collaboration in R&D and own internal R&D facilities. Although her sample referred to Flemish innovative companies she included a variable that aimed to capture multinationality and in particular subsidiary differentiation. The results on this variable indicated a more centralized strategy in R&D resulting in subsidiaries that do not own R&D facilities. However, when AC is positive then cooperative strategies of foreign affiliates “have a larger positive effect on internal R&D” (p. 313).

In this paper, we study In this paper, we study the evolution of AC of foreign subsidiaries. Following the distinction of Zahra and George of *potential and realized* AC and building on their influential work we put forward the following Research Questions (RQ):

**RQ 1:**

*A subsidiary’s further strengthening of realized AC depends on the degree of independence of the subsidiary, prior realized AC of the MNC group as well as on the potential AC of the subsidiary.*

**RQ 2:**

*The intensity of a subsidiary’s own realized AC depends on the dynamic interaction between its external and its internal environment (Penrose’s ‘productive opportunity’).*

**RQ 3:**

*A subsidiary’s performance will be determined by the existence or not of realized and potential AC.*

By incorporating individual subsidiary roles and internal and external to the MNC group sources of technology, including various types of in-house R&D laboratories, and by measuring *realized and potential AC*, we aim to overcome some limitations of extant quantitative measures of R&D (Zahra and George, 2002).

The central idea evolves around the notion that the total AC (and thus the performance) of an MNC exhibits some form of feedback between *potential* and *realized* AC of its subsidiaries. In the event of such a feedback relationship, one can think that the expected profits of a subsidiary (and by implication the expected profits of the MNC) depend on the decision to further develop its *realized* AC by establishing or not a (foreign) R&D lab; the assumption being that by making this decision and assigning a role to a new R&D lab, the subsidiary moves one step ahead to transform and adapt acquired external knowledge to its particular needs. One can envisage that such a binary decision (to establish a new R&D lab or not) may be influenced by a number of factors both internal to the subsidiary and external (relating to environment).

Once a subsidiary has reached its decision on establishing its own R&D laboratory, it enters the second phase of knowledge transformation and exploitation augmenting its existing *realized* AC by own operations and scientific personnel. By assigning different roles to R&D laboratories the subsidiary discriminates among them into four different levels. These are R&D laboratories are distinguished in those that aim at developing new products for the MNC group, those with the aim to provide advice on adaptation or development to other subsidiaries, the ones that aim at adapting processes and products to existing markets and finally the ones that carry out basic research. Hence, there is a qualitative ordering of *realized* AC. In this sense, we are interested in examining the significance of *realized* AC as a source of technology for the subsidiary according to this qualitative classification. Hence, at this stage, it is important to assess the significance of the particular laboratory as a source of subsidiary's technology based on the roles that managers assign to them *ex ante*. To test this we again utilize variables capturing *realized* and *potential* AC as well as roles of subsidiaries and roles of R&D laboratories as indicated above.

The next interesting question that arises then is connected with the impact of prior realized and potential AC on the subsidiary's performance, thus the performance of the entire MNC group.

### **3. Data description, econometric methodology and variables**

In order to empirically test the aforementioned hypotheses, data derived from a questionnaire survey will be applied. This survey is an updated version of a questionnaire survey designed and tested by Pearce and Singh in 1988-1990 (Pearce and Singh, 1992). Both surveys aimed at investigating the positioning of overseas R&D in foreign MNC subsidiaries and contain questions that: (1) Define subsidiary roles, (2) Define internal and external to the MNC group sources of technology, which can be accessible by overseas subsidiaries and (3) Define overseas R&D roles<sup>2</sup>.

The survey was carried out in 1994/95. Experienced academics were consulted with regards to particular phrasing and sequence of questions asked. The final version of the questionnaire was posted to 812 subsidiaries operating in the UK<sup>3</sup> (see for full description Papanastassiou and Pearce, 1999) extracted from the International Directory of Corporate Affiliations (1992). The sampling process aimed at subsidiaries with parent - companies enlisted in Fortune 500.

The questionnaire was sent twice within a month's time. We collected 190 replies, for a response rate of 23.3%. This response rate compares favourably with the ones obtained in similar surveys (Harzing, 1997). We excluded one reply due to inadequate information, thus we finally ended up with 189 valid responses.

Based on our modeling directions posed we employ the following econometric methodology: The binary nature of the decision involved in (a) naturally calls for inference methods of qualitative choice (categorical) models, of the probit and logit variety; in addition, one could employ conditional chi-square tests between the choice variable and other qualitative and quantitative explanatory variables as an additional method for examining which of the explanatory variables appear to be independent of

---

<sup>2</sup> A brief description of the survey may be found in Appendix.

<sup>3</sup> See Papanastassiou and Pearce (1999) for full description.

the decision of establishing a lab. For the analysis in part (b) we use inference methods that allow us to examine whether or not the establishment of a lab leads to differentiated performance and changes in absorptive capacity. These methods include (i) standard regressions with a variety of performance and AC measures as dependent variables and a number of control explanatory variables, followed by hypotheses tests on the issue of differentiated performance; (ii) a variety of moment and distributional tests on the above dependent variables trying to examine in an alternative way whether the presence of a lab matters – note that the application of distributional tests strengthens the regression and moment tests results, as they look on the entire distribution of the variables for judging differentiated performance and not just a few sample moments; (iii) nonparametric regressions, which are extremely suitable for examining whether the response of performance and AC in changes in control variables and/or lab establishment has a particular shape (other than linear) that could have an economic interpretation.

Throughout our analysis, we control for the origin of parent firm, the type of industry, the entry mode of the subsidiary in the local market as well as the period that it operates<sup>4</sup> so as to isolate the effects of *prior potential and realized AC* as well as the type of the subsidiary.

The dependent variable of RQ1 is the existence or not of a R&D laboratory, taking thus the value of 1 (existence) and 0 otherwise. To check for this RQ, we use responses from question 7 of the questionnaire which are categorized as potential and realized AC. In particular, and based on Zahra and George (2002), those variables that relate to acquisition and assimilation are assigned as potential and those reflecting knowledge transformation and exploitation are depicted as realized. Based on the above, R&D carried out by local scientific institutions for the subsidiary and R&D carried out in collaboration with another firm fall within the potential AC group, since they directly relate to the external environment of the subsidiary, thus pinpoint the subsidiary's efforts to acquire and assimilate knowledge from surroundings.

---

<sup>4</sup> All these variables come from the questionnaire.

On the other hand, all other variables that indicate technology stemming from either the MNC group or the subsidiary itself show evidence of the transformation and exploitation of acquired knowledge into particular needs of the MNC and the subsidiary<sup>5</sup>.

In regards to RQ2, the dependent variable is the ordered answer (from 4 to 1) of question 7 as the source of technology based on the formulation discussed above. In this model we also use measures of potential and realized AC that we used in RQ1, however, given that this is the second stage in the developmental process of subsidiary's AC, the firm has another element of *realized* AC, that of scientific personnel hired to equip the laboratory, thus we also include here the number of scientific personnel as an extra variable of *realized* AC.

Finally, the dependent variable for investigating the impact of *potential and realized* AC of the subsidiary is the total turnover<sup>6</sup>. In this stage, the R&D laboratory is in operation, thus, besides realized AC belonging primarily to the MNC group, the subsidiary has further enhanced its AC by developing its own research unit, hence in addition to variables of realized and potential AC used above, we hereby include the presence of an R&D lab<sup>7</sup>.

## 5. Results

Each one of the three RQs was estimated by three independent regression models. The definition of the variables used in the tables below as well as selected sample correlation matrices showing the strength of association between groups of variables may be found in the Appendix. The results of conditional  $X^2$  tests that examine the

---

<sup>5</sup> For a description of variables falling into either of the two categories, see Appendix A, section 2.

<sup>6</sup> A number of performance variables are possible. Our focus on sales is in line with the focus of the resource-based view (RBV), and in particular Penrose's view (see Pitelis, 2002, for an extensive discussion).

<sup>7</sup> We do not include the number of scientific personnel here, because this belongs to the R&D lab, so by including the existence of the laboratory by definition includes the scientific personnel engaged in this.

lack of independence among pairs of variables of interest are also available on request.

**RQ1:**

**Model I: Assessing the impact of AC on the likelihood of establishing an R&D lab- Table 1.**

Our results show that the likelihood of establishing an R&D lab thus, strengthening *realized* AC significantly depends on prior *potential* AC of the subsidiary: the higher is the dependence of the subsidiary on external AC the higher is the likelihood of establishing an R&D lab; note that other measures of AC do not enter significantly on the equation although it appears that the higher is the dependence of the subsidiary on existing AC (internal technology and R&D), the lower is the likelihood of establishing an R&D lab. It follows that exposure to external knowledge seems to enhance the further building of AC by inducing subsidiaries to develop their own R&D lab in order to be able to transform according to the fourth dimension of Zahra and George (2002) acquired knowledge to their own procedures and technologies adopted to their own needs.

The novel predictors we use, adding to the existing literature on AC as discussed above, involve the roles of subsidiaries. Results indicate that subsidiaries aiming at developing and producing new products (WPM) and subsidiaries aiming at producing and exporting already existing products (SMR) are more likely to develop an R&D laboratory, unlike subsidiaries that target the internal (UK) market only (TMR).

As regards to the control variables, we find that the longer a subsidiary operates in a particular location, the most likely it is to create its own R&D unit. We also note that new companies and joint ventures decrease the likelihood of establishing a lab (if the method of establishing the subsidiary is taking over an existing company then the corresponding coefficient is positive, thus increasing the likelihood of establishing an R&D lab).

-----  
Table 1 about here  
-----

**RQ2:**

**Model II: Assessing the impact of the type of an existing R&D lab on the importance of the lab's research as a source of technology for the subsidiary-  
Table 2**

The importance of an established lab's research as a source of technology for the subsidiary significantly depends on the number of scientific personnel (*realized* AC) while the dependence of the subsidiary on internal to the MNE group technology lowers the importance of the established R&D lab as a source of technology.

Potential AC as captured by the collaborations of the subsidiary with other firms, enhances the significance of an R&D lab as a source of technology.

With respect to the role of the subsidiary: the R&D lab appears to be of high importance as a source of technology for subsidiaries that develop and produce new products and the other way around for subsidiaries that produce and export intermediate goods. Note that, as in Model I, the impact from the role of the subsidiary in developing and producing new products is higher than that of the other roles of the firm (the coefficient of WPM1 is higher in absolute magnitude).

Turning to the type of the R&D unit, if the lab was established to either develop new products for the subsidiary's market or to carry out basic research then it increases the importance of its research as a source of technology for the subsidiary. The lab's importance as a source of technology is higher if it has been established for developing and producing new products for the firm's market than if it has been

established to carry out basic research (the coefficient of LIL1 is higher in absolute magnitude).

-----  
Table 2 about here<sup>8</sup>  
-----

### **RQ3:**

#### **Model III: Assessing the impact of establishing an R&D lab on the performance of the subsidiary (as measured by total turnover)<sup>9</sup> - Table 3**

It appears that the *realized* AC plays an important role in the subsidiary's performance. It is noteworthy that among the various measures of *realized* AC, operating a R&D laboratory significantly increases the subsidiary's sales. Also, prior *realized* AC, i.e., the dependence of the subsidiary on internal technology (from within its MNE group) enhances its performance.

Regarding roles of the subsidiaries, those established in order to produce and export existing products turn out to have higher sales contrary to subsidiaries that were established in order to develop and produce new products.

-----  
Table 3 about here  
-----

## **6. Concluding remarks and policy implications**

The goal of our research effort is to make a new proposal in the modeling of AC where the focal unit of analysis is the MNC subsidiary by bringing together different

---

<sup>8</sup> The table presents only variables that are statistically significant besides the control variables.

<sup>9</sup> A number of performance variables are possible. Our focus on sales is in line with the focus of the resource-based view (RBV), and in particular Penrose's view (see Pitelis, 2002, for an extensive discussion).



conceptual perspectives. Building on Zahra and George (2002) and Veugelers (1997) we use the existence of an R&D lab as a measure of a subsidiary's *realized* AC and we explore the impact of *potential* and *realized* AC on the performance of a subsidiary by developing and testing 3 RQs, using primary data collection through a questionnaire survey.

Our results point to the significance of the *potential* AC in further enhancing the *realized* AC of a subsidiary as it may be captured by the establishment of an R&D laboratory, whilst other measures of *realized* AC, i.e., the scientific personnel acts complementarily and enhances the significance of an existing R&D unit as the subsidiary's source of technology.

Clear implications follow from the above vis-à-vis managerial practice, notably the performance of a subsidiary and the MNC group as a whole benefit from the establishment of an R&D lab, by enhancing the subsidiaries AC. Further research, with additional data and further hypotheses and tests, is needed to support our early findings – we are pursuing some of these directions but also hope to motivate others.

## References

- Andersson, U. and Forsgren, M. (2000) 'In Search of Centre of Excellence: Network Embeddedness and Subsidiary Roles in Multinational Corporations', *Management International Review*, 40: 329-350.
- Bartlett, C.A. and Ghoshal, S. (1989) *Managing Across Borders: The Transnational Solution*. Harvard Business School Press: Boston.
- Birkinshaw, J. (1996) 'How multinational subsidiary mandates are gained and lost', *Journal of International Business Studies*, 27: 467-495.
- Birkinshaw, J., Hood, N. and S. Jonsson, (1998) 'Building firm specific advantages in Multinational Corporations: The role of subsidiary initiative', *Strategic Management Journal*, 19: 221-241.
- Birkinshaw, J., Nobel, R. and J. Ridderstrale (2002) 'Knowledge as a contingency variable: Do the characteristic of knowledge predict organizational structure?', *Organization Science*, 13 (3): 274-289.
- Buckley, P. and Casson, M. (1976) *The Future of Multinational Enterprise*. Macmillan: London.
- Cantwell, J. and Janne, O. (1999) 'Technological globalization and innovative centers: The Role of corporate technological leadership and locational hierarchy', *Research Policy*, 28: 119-144.
- Chiesa, V. (2000) 'Global R&D project management and organization: A taxonomy', *Journal of Product Innovation Management*, 17 (5): 341-359.
- Cohen, W. and Levinthal, D. (1989) 'Innovation and learning: The two faces of R&D', *The Economic Journal*, 99 (397): 569-596.
- Cohen, W. and Levinthal, D. (1990) 'Absorptive capacity: A new perspective on learning and innovation', *Administrative Science Quarterly*, 35(1), 128-152.
- Crookel, H. and Morrison, A. (1990) 'Subsidiary Strategy in a Free Trade Environment', *Business Quarterly*, Autumn: 33-39.
- Daghfous, A. (2004) 'Absorptive capacity and the implementation of knowledge-intensive best practices', *SAM Advanced Management Journal*, 69(2), 21-27.
- Dunning, J.H. (2000) 'The Eclectic Paradigm as an Envelope for Economic and Business Theories of MNE Activity', *International Business Review*, 9: 163-190.

- Dunning, J. H. and Pitelis, C. N. (2005) 'If Hymer were writing now?: an assessment of Stephen Hymer's contribution to 'International Business' scholarship', *Mimeo*, Universities of Reading, Rutgers and Cambridge.
- Gassmann O. and Han Z. (2004) 'Motivations an barriers of foreign R&D activities in China', *R&D Management*, 34 (4): 423-437.
- Frenz, M., Michie, J. and Oughton, C. (2004) 'Co-operation, innovation, and firm's absorptive capacity', *Working Paper No. 12, Birmingham*.
- Håkanson, L. and Nobel, R. (2001) 'Organizational characteristics and reverse technology transfer', *Management International Review*, 41: 395-420.
- Hedlund, G. (1986) 'The hypermodern MNC: A Heterarchy', *Human Resource Management*, 25: 9-35.
- Hirsch, S. (1976) 'An International trade and investment theory of the Firm', *Oxford Economic Papers*, 28 (2): 228-239.
- Hymer, S. (1976/1960) *The international operations of national firms: a study of direct investment*. Ph.D. dissertation, MIT, USA.
- Ivarsson, I. and Jonsson, T. (2003) 'Local technological competence and asset-seeking FDI: An empirical study of manufacturing and wholesale affiliates in Sweden', *International Business Review*, 12: 369-386.
- Kamien, M.I. and Zang, I. (2000) 'Meet me half-way: research joint ventures and absorptive capacity', *International Journal of Industrial Organization*, 18, 995-1012.
- Kedia, B.L. and Bhagat, R.S. (1988) 'Cultural constraints on transfer of technology across nations: Implications for research in international and comparative management', *Academy of Management Review*, 13, 559-573.
- Kim, L. (1997) *From Imitation to Innovation: The Dynamics of Korea's Technological Learning*, Cambridge, MA, Harvard Business School Press.
- Kim, L. (1998) 'Crisis construction and organizational learning: Capability building in catching up at Hyundai Motor', *Organization Science*, 9, 506-521.
- Kuemmerle, W. (1999) 'The drivers of Foreign Direct Investment in research and development: An empirical investigation', *Journal of International Business Studies*, 30 (1): 1-24.
- Lane, P.J., Salk, J.E. and Lyles, M.A. (2001) 'Absorptive capacity, learning and performance in international joint ventures', *Strategic Management Journal*, 22, 1139-1161.

- Lane, P.J., Koka, B. and Pathak, S. (2002) 'A thematic analysis and critical assessment of absorptive capacity research', *Academy of Management Proceedings 2002 BPS: M1*.
- Leahy, D. and Neary, J.P. (2004) 'Absorptive capacity, R&D spillovers and public policy', *CEPR Discussion Papers No. 4171, London*.
- Mahnke, V., Pedersen, T. and Venzin, M. (2005) 'The impact of knowledge management on MNC subsidiary performance; the role of absorptive capacity', *Journal of International Business (forthcoming)*.
- Manolopoulos, D., Papanastassiou, M., and Pearce, R. (2005) 'Technology sourcing in MNEs and the roles of subsidiaries: An empirical investigation', *International Business Review*, 14 (3): 249-267.
- Minbaeva, D., Pedersen, T., I. Bjorkman, C.Fey and H.J. Park (2003) 'Knowledge Transfer, Subsidiary ACand HRM', *Journal of International Business Studies*, 34: 586-599.
- Mowery, D.C. and Oxley, L.E. (1995) 'Inward technology transfer and competitiveness: The role of national innovation systems', *Cambridge Journal of Economics*, 19, 67-93.
- Oltra, M.J. and Flore, M. (2003) 'The impact of technological opportunities and innovative capabilities on firms' output innovation' *Creativity & Innovation Management*, 12(3), 137-145.
- Papanastassiou, M. and Pearce, R. (1999) *Multinationals, Technology and National Competitiveness*, Edward Elgar Press: London.
- Patel, P. and Vega, M. (1999) 'Patterns of internationalization of corporate technology: Location versus home country advantages', *Research Policy*, 28: 145-155.
- Pearce, R. and Papanastassiou, M. (1996) *The Technological Competitiveness of Japanese Multinationals: The European Dimension*, Michigan University Press: Michigan.
- Pearce, R. and Singh, S. (1992) *Globalizing Research and Development*. St Martin Press: New York.
- Penrose, E.T. (1959/1995) *The Theory of the Growth of the Firm*, Oxford University Press: Oxford, 3rd edn.
- Pitelis, C. N. (ed.) (2002), *The Growth of the firm: the legacy of Edith Penrose*, Oxford University Press: Oxford.

Rothwell, R. and Dodgson, M. (1991) 'External linkages and innovation in small and medium-sized enterprises', *R&D Management*, 21, 125-137.

Schmidt, T. (2005) 'Absorptive capacity – one size fits all? A firm-level analysis of absorptive capacity for different kinds of knowledge', *Centre for European Economic Research, Discussion Paper No. 05-72*.

Van den Bosch, F., Volberda, H. and de Boer M. (1999) 'Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities', *Organization Science*, 8, 98-118.

Van den Bosch, F., Van Wijk, R. and Volberda, H. (2003) *Absorptive Capacity: Antecedents, Models and Outcomes*, Blackwell Handbook of Organizational Learning & Knowledge Management, 278-301.

Veugelers, R. (1997) 'Internal R&D expenditures and external technology sourcing', *Research Policy*, 26: 303-315.

Vinding, A.L. (2000) 'Absorptive capacity and innovation performance: A human capital approach', *Department of Business Studies-DRUID/IKE Group*, Aalborg University, Denmark.

Welsch, H., Liao, J. and Stoica, M. (2001) 'Absorptive capacity and firm responsiveness: An empirical investigation of growth-oriented firms', *Proceedings of 2<sup>nd</sup> USASBE/SBIDA Conference, An Entrepreneurial Odyssey*, Orlando, USA.

World Investment Report (2004) *The shift towards services*, UNCTAD: Geneva.

Zahra, S.A. and George, G. (2002) 'Absorptive capacity: a review, reconceptualization, and extension', *Academy of Management Review*, 27 (2): 185-203.

**Table 1: Assessing the impact of AC on the likelihood of establishing an R&D lab**

Dependent Variable: LAB

Estimation Method: ML - Binary Logit

Observations used in estimation: 173

Robust std. errors from QML covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-5.662122	1.559341	-3.631100	0.0003
EU	2.718055	0.925917	2.935529	0.0033
AM	2.243892	0.950761	2.360101	0.0183
PAC	2.687756	0.968915	2.773986	0.0055
SDH	1.060391	0.393084	2.697620	0.0070
YO	0.027714	0.009201	3.012031	0.0026
NC	-0.887073	0.548129	-1.618367	0.1056
JV	-1.513314	0.808497	-1.871762	0.0612
TMR1	-0.492587	0.225744	-2.182062	0.0291
SMR	0.590326	0.231013	2.555379	0.0106
WPM1	0.918695	0.240056	3.826997	0.0001
EXTT	0.837603	0.416383	2.011615	0.0443
EXST	0.101017	0.292255	0.345646	0.7296
MNET	-0.158813	0.226687	-0.700584	0.4836
MNERD	-0.023550	0.218030	-0.108011	0.9140
COLRD	-0.255565	0.351836	-0.726375	0.4676
Log likelihood	-85.52783	Hannan-Quinn criter.	1.292046	
Restr. log likelihood	-118.8690	Avg. log likelihood	-0.494381	
LR statistic (15 df)	66.68235	McFadden R-squared	0.280487	
Probability(LR stat)	1.73E-08			

**Table 2: Assessing the impact of the type of an existing R&D lab on the importance of the lab's research as a source of technology for the subsidiary**

Dependent Variable: OWNRD

Estimation Method: ML - Ordered Logit

Observations used in estimation: 86 (if LAB = 1)

Robust std. errors from QML covariance

	Coefficient	Std. Error	z-Statistic	Prob.
EU	-2.019458	1.368237	-1.475956	0.1400
AM	-2.480446	1.471074	-1.686146	0.0918
PAC	-3.202927	1.550129	-2.066232	0.0388
SDH	-0.188542	0.664942	-0.283547	0.7768
AGE	0.009156	0.010890	0.840768	0.4005
NOPER	0.002468	0.001102	2.239616	0.0251
RPS1	-1.000947	0.470813	-2.125999	0.0335
WPM1	1.379544	0.390908	3.529072	0.0004
MNET	-1.025456	0.485460	-2.112338	0.0347
COLRD	1.277805	0.585120	2.183834	0.0290
IIL1	1.004037	0.337238	2.977232	0.0029
LIL1	1.583681	0.597474	2.650630	0.0080
Log likelihood	-50.51169	Hannan-Quinn criter.	1.695812	
Restr. log likelihood	-73.99900	Avg. log likelihood	-0.587345	
LR statistic (12 df)	46.97463	LR index (Pseudo-R2)	0.317400	
Probability(LR stat)	4.71E-06			

**Table 3: Assessing the impact of establishing an R&D lab on the performance of the subsidiary as measured by total turnover**

Dependent Variable: LOG(TS)

Estimation Method: Least Squares

Observations used in estimation: 173

Robust std. errors from HC covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.223286	0.491904	0.453921	0.6505
LAB	0.786801	0.255314	3.081696	0.0024
EU	1.051849	0.339233	3.100665	0.0023
AM	1.160466	0.351942	3.297321	0.0012
PAC	0.516958	0.304377	1.698414	0.0913
SDH	0.103364	0.226592	0.456166	0.6489
SMR	0.441065	0.124627	3.539085	0.0005
WPM1	-0.213338	0.127404	-1.674501	0.0959
MNET	0.426315	0.121013	3.522895	0.0006
R-squared	0.241091	Mean dependent var		3.123141
Adjusted R-squared	0.204071	S.D. dependent var		1.626555
S.E. of regression	1.451129	Akaike info criterion		3.633182
Sum squared resid	345.3471	Schwarz criterion		3.797226
Log likelihood	-305.2702	F-statistic		6.512446
		Prob(F-statistic)		0.000000



## Appendix A

### Definitions of variables

<b>EU</b>	Dummy for Europe
<b>AM</b>	Dummy for Americas
<b>PAC</b>	Dummy for Pacific
<b>SDH</b>	Sector dummy for high technology
<b>SDM</b>	Sector dummy for medium technology
<b>YO</b>	Years of operation
<b>TO</b>	Subsidiary established through take over
<b>NC</b>	Subsidiary established through new company
<b>JV</b>	Subsidiary established through joint venture
<b>TS</b>	Total sales
<b>SG</b>	Proportion of sales in MNE group
<b>SE</b>	Proportion of sales that is exported
<b>EG</b>	Proportion of exports to group
<b>IG</b>	Proportion of exports as intermediate goods
<b>TMR1</b>	Question 6a in main text
<b>SMR</b>	Question 6b in main text
<b>RPS1</b>	Question 6c in main text
<b>WPM1</b>	Question 6d in main text
<b>EXST</b>	Question 7a in main text
<b>MNET</b>	Question 7b in main text
<b>OWNRD</b>	Question 7c in main text
<b>MNERD</b>	Question 7d in main text
<b>COLRD</b>	Question 7e in main text
<b>EXTT</b>	Question 7f in main text
<b>LAB</b>	Dummy for existence of an R&D lab
<b>AGE</b>	Age of lab
<b>NOPER</b>	Number of researchers
<b>GROWTH</b>	Growth dummy (subjective)
<b>DECLINE</b>	Decline dummy (subjective)
<b>SL1</b>	Question 9a in main text
<b>LIL1</b>	Question 9b in main text
<b>SLMNE1</b>	Question 9c in main text
<b>IIL1</b>	Question 9d in main text

## 2. Groupings of variables in *realized* and *potential* AC

<b>EXST</b>	Question 7a in main text	Realized AC
<b>MNET</b>	Question 7b in main text	Realized AC
<b>OWNRD</b>	Question 7c in main text	Realized AC
<b>MNERD</b>	Question 7d in main text	Realized AC
<b>COLRD</b>	Question 7e in main text	Potential AC
<b>EXTT</b>	Question 7f in main text	Potential AC
<b>LAB</b>	Dummy for existence of an R&D lab	Realized AC
<b>NOPER</b>	Number of researchers	Realized AC

**Correlation Table 1. Establishment of a Lab with Scope of Subsidiary**

	LAB	TMR1	SMR	RPS1	WPM1
LAB	1.000000				
TMR1	-0.193141	1.000000			
SMR	0.112956	0.290524	1.000000		
RPS1	0.007929	0.060247	0.220117	1.000000	
WPM1	0.390211	-0.333628	-0.098711	-0.026497	1.000000

**Correlation Table 2. Establishment of a Lab with Sources of Knowledge**

	LAB	EXST	MNET	MNERD	COLRD	EXTT
LAB	1.000000					
EXST	0.046118	1.000000				
MNET	-0.031362	0.043305	1.000000			
MNERD	-0.077378	0.079981	0.143637	1.000000		
COLRD	0.112507	0.010974	0.108118	0.144122	1.000000	
EXTT	0.248561	-0.000445	0.058629	0.003448	0.462554	1.000000

**Correlation Table 3. Importance of Own R&D as a Source of Technology  
with Scope of Subsidiary**

	OWNRD	TMR1	SMR	RPS1	WPM1
OWNRD	1.000000				
TMR1	-0.090670	1.000000			
SMR	-0.159754	0.328076	1.000000		
RPS1	-0.115502	0.087797	0.215389	1.000000	
WPM1	0.452945	-0.328012	-0.295203	-0.134186	1.000000

**Correlation Table 4. Importance of Own R&D as a Source of Technology  
with Other Sources of Knowledge**

	OWNRD	EXST	MNET	MNERD	COLRD	EXTT
OWNRD	1.000000					
EXST	0.017283	1.000000				
MNET	-0.173422	-0.039133	1.000000			
MNERD	-0.121749	0.058517	0.313032	1.000000		
COLRD	0.157028	0.037127	0.059171	0.197637	1.000000	
EXTT	0.171421	-0.044613	-0.058248	-0.096421	0.411263	1.000000

**Correlation Table 5. Importance of Own R&D as a Source of Technology  
with Function of an Established Lab**

	OWNRD	SL1	LIL1	SLMNE1	IIL1
OWNRD	1.000000				
SL1	-0.084189	1.000000			
LIL1	0.193100	0.237736	1.000000		
SLMNE1	0.176796	-0.059662	0.030708	1.000000	
IIL1	0.223316	-0.419027	-0.196662	0.343903	1.000000

## Appendix B

### Questionnaire

1. How your company was originally established? (please tick relevant answer)
  - a) by the takeover of an existing UK company
  - b) by the creation of a new company with its own production facilities
  - c) s a joint venture with an existing UK company
2. What is the current sales/turnover of the subsidiary?
3. What percentage of the sales of the whole MNE group of which the subsidiary is part, does its sales represent?
4. What proportion of your production is exported?
5. What percentage of your exports go to other parts of the MNE group?
6. Please grade each of the following roles in terms of their importance in your operation as:

*(4) our only role*

*(3) our major role*

*(2) a secondary role*

*(1) not a part of our role*

a) to produce for the UK market products that are already established in our MNC's group product range

b) to play a role of the MNC's European supply network by specializing in the production and export of part of the established product range

c) to play a role of the MNC's European supply network by producing and exporting component parts for assembly elsewhere

d) to develop, produce and market for the UK and/or European or (wider) markets, new products additional to the MNE group's existing range

7. Please grade the following sources of technology for your operation as:



- (4) our only source of technology*
- (3) our major source of technology*
- (2) a secondary source of technology*
- (1) not a source of technology*

- (a) existing technology embodied in established products we produce.
- (b) technology of our MNE group from which we introduce new products for the UK/European market that differ from other variants introduced in other markets
- (c) R & D carried-put by our own laboratory
- (d) R&D carried out for us by another R&D laboratory of our MNE group
- (e) R & D carried out in collaboration with another firm
- (f) R&D carried out for us by local scientific institutions (e.g., universities, independent laboratories, industry laboratories)
- g) development and adaptation carried out less formally by members of our engineering unit and production personnel

8. If your subsidiary has its own R&D laboratory to support its operations

- a) when was it set up?
- b) How many scientific personnel does it employ?

9. If your subsidiary has its own R&D laboratory to support its operations, please grade as:

- (4) its only role*
- (3) its major role*
- (2) a secondary role*
- (2) not a part of its role*

- (a) adaptation of existing products and/or processes to make them more suitable to our markets and conditions
- (b) to play a role in the development of new products for our distinctive markets

(c) to provide advice on adaptation and/or development to other producing subsidiaries of our MNE group

(d) to carry out basic research (not directly related to our current products) as part of a wider MNE group level research program

## *Internationalization of R&D and Absorptive Capacity: A conceptual Framework*

